

tenuato; apertura verticali, subovali, marginibus callo crasso restricto junctis; columella arcuata; labro sinuato, obtuso, intus vix crenulato.

Long. 6, diam. 9 mill. Apert. intus 6 mill. longa, 4 lata.

Hab. Borneo.

POROMYA FORBESI, H. Ad. (Plate LXIX. fig. 6.)

P. testa transversa, subovali, ventricosa, tenui, albida, subpellucida, radiatim exiliter punctata, epidermide tenui flavida scabra induta; umbonibus tumidis, eminentibus, submedianis: extremitate anteriori ovata; extremitate posteriori oblique truncata, ad marginem dorsalem compressa; margine ventrali arcuato.

Long. 20, alt. 14, lat. 9 mill.

Hab. —?

The genus *Poromya* of Forbes (= *Embla* of Lovén) has been considered to be synonymous with *Thetis* of Sowerby and *Eucharis* of Récluz. It should be kept separate from both, and they also be recognized as distinct genera. *Thetis*, of which I am not aware of there being any recent species, appears to belong to the family Veneridæ, while the others are members of Corbulidæ.

P.S.—Since writing the above I find that a specimen of *Neritopsis radula*, with its operculum, has been received by Dr. Souverbie from Ouagap, one of the Caroline Islands, and that the operculum has been described by him in the April Number of the 'Journal de Conchyliologie.'

EXPLANATION OF PLATE LXIX.

- Fig. 1, 1 a. *Apicalia holdsworthi*, p. 585.
 2. *Tudicla spirilla*, p. 585.
 3. *Barclayia incerta*, p. 585.
 4, 4a, 4b. Operculum of *Neritopsis radula*, p. 585.
 5, 5 a. *Paludomus luteus*, p. 585.
 6. *Poromya forbesi*, p. 586.

6. On some Points in the Anatomy of the Parrots which bear on the Classification of the Suborder. By A. H. GARROD, B.A., F.Z.S., Fellow of St. John's College, Cambridge, Prosector to the Society.

[Received September 15, 1874.]

(Plates LXX. & LXXI.)

In a former communication*, a review of certain of the most variable characters found amongst the *Columbæ* enabled me to give hints with regard to the mutual relationships of the different genera of that considerable family, which I hope will be found of service. On the present occasion it is my desire to follow out a similar method, taking the *Psittaci*, a suborder quite as, and perhaps even more, difficult to arrange by external features only.

* P. Z. S. 1874, p. 249.

Furcula Lost:
Ambiens variable

$\frac{2}{2} \cdot \text{---} \cdot \text{+} \cdot \text{+}$

Stringops
Geopsittacus
Euphonia
Melopsittacus

Ambiens Lost

$\frac{2}{2} \cdot \text{---} \cdot \text{+} \cdot \text{+} \cdot \text{+}$

Ptilinopus
Eudactis
Aprosmictus
Tanygnathus
Ptilinopus
Psittacus
Trichoglossus
Eos
Lorius
Loriculus

Orbital Ring
Characteristic

$\frac{2}{2} \cdot \text{---} \cdot \text{+} \cdot \text{+}$

Eolophus
Lianetus
Calyptorhynchus
Calopsitta

Right Carotid
Lost

$\frac{1}{1} \cdot \text{---} \cdot \text{+} \cdot \text{+}$

Cacatua

Furcula Lost

$\frac{2}{2} \cdot \text{---} \cdot \text{+} \cdot \text{+}$

Stringops
Geopsittacus
Melopsittacus
Euphonia
Agapornis

Left Carotid
became Superficial

$\frac{2}{2} \cdot \text{+} \cdot \text{+} \cdot \text{+} \cdot \text{+}$

Psittacus
Pyrocephalus
Nesotus
Citra
Eulporhynchus
Conusus
Ara

Ambiens Lost

$\frac{2}{2} \cdot \text{---} \cdot \text{+} \cdot \text{+}$

Pyrrhuloxia
Coracopsis
Iathianus
Pyrrhura

Furcula Lost

$\frac{2}{2} \cdot \text{---} \cdot \text{+}$

Platyceus
Psephotus
Cyanorhamphus
Psittacula

Oil-gland Lost

$\frac{2}{2} \cdot \text{---} \cdot \text{+} \cdot \text{+}$

Chrysotis
Promus
Brotogeris

Type Form
Extinct

possessing

1. Two normal Carotids
2. In Ambiens muscle
3. In Furcula
4. In Oil-gland

$\frac{2}{2} \cdot \text{+} \cdot \text{+} \cdot \text{+} \cdot \text{+}$

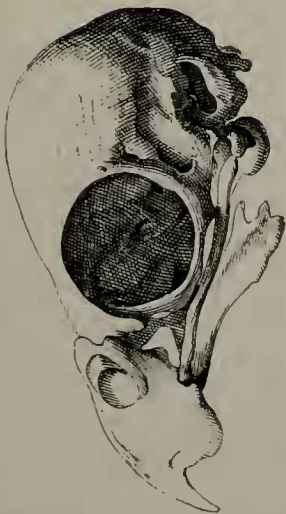
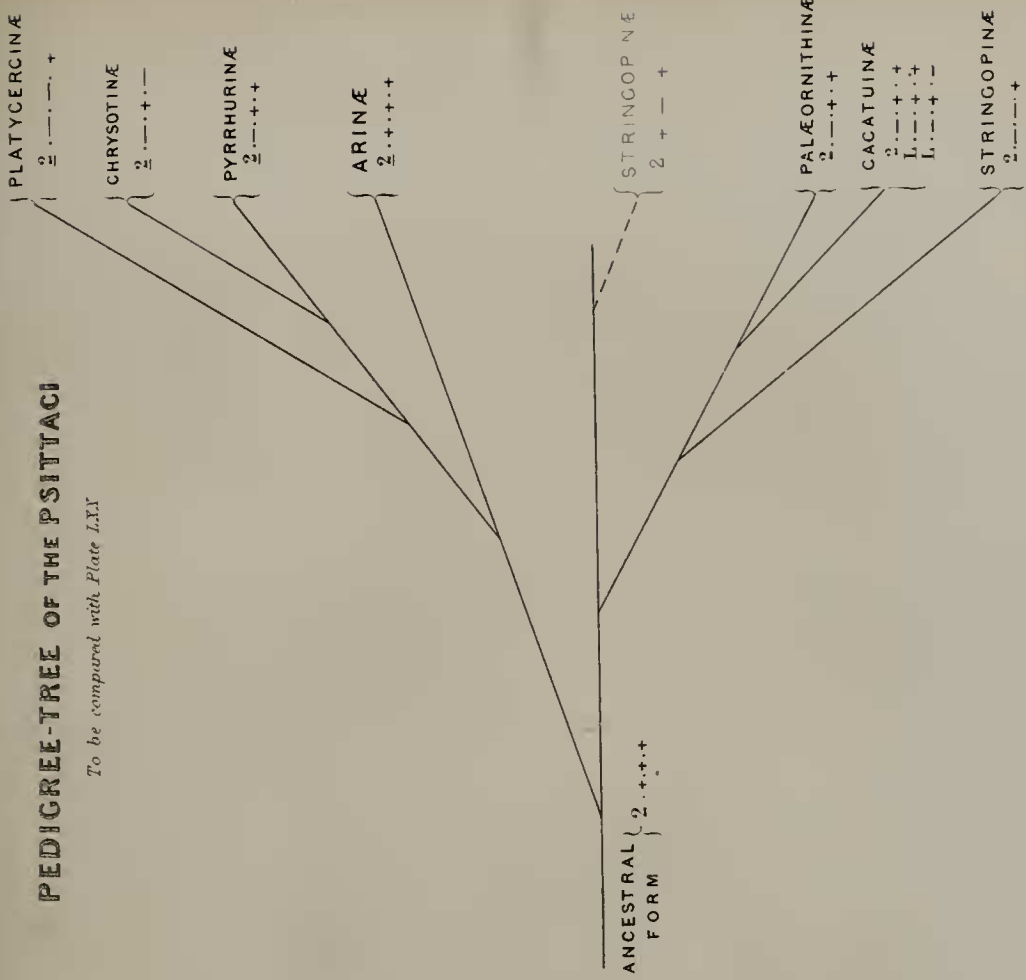
CLASSIFICATION OF PARROTS

The formulæ in the circles are explained in the text, as are the dotted circle and the included lighter type



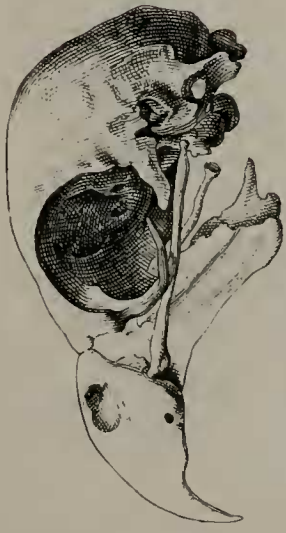
PEDIGREE-TREE OF THE PSITTACI

To be compared with Plate LXX



EOLOPHUS ROSEICAPILLUS

Showing the complete orbital ring with the extra temporal process characteristic of the Cacatuzinæ



PYRRHULOPSIS SPLENDENS

Showing the incomplete orbital ring & the absence of the temporal process



The unequalled collection of living Parrots in the Society's Gardens, and the liberality of friends, have placed at my disposal specimens of the large number of 82 species, in all of which I have been able to note the characters laid stress on in this paper. To save repetition a list is here given of the species examined by me; and on all future occasions when a genus only is mentioned, it refers to those species of it which are contained in this list.

Names of Species examined.

<i>Agapornis roseicapilla.</i>	<i>Eos riciniata.</i>
<i>Aprosmictus erythropterus.</i>	<i>Euphema aurantia.</i>
— <i>scapulatus.</i>	— <i>bourkii.</i>
<i>Ara ambigua.</i>	— <i>pulchella.</i>
— <i>ararauna.</i>	— <i>splendida.</i>
— <i>macao.</i>	<i>Geopsittacus occidentalis.</i>
— <i>maracana.</i>	<i>Lathamus discolor.</i>
<i>Bolborhynchus monachus.</i>	<i>Licmetis pastinator.</i>
<i>Brotogeris tiriacula.</i>	<i>Loriculus asiaticus.</i>
— <i>tovi.</i>	— <i>chrysonotus.</i>
— <i>pyrrhopterus.</i>	— <i>galgulus.</i>
— <i>virescens.</i>	<i>Lorius cardinalis.</i>
<i>Cacatua cristata.</i>	— <i>lori.</i>
— <i>galerita.</i>	— <i>tricolor.</i>
— <i>leadbeateri.</i>	<i>Melopsittacus undulatus.</i>
— <i>sulphurea.</i>	<i>Nestor meridionalis.</i>
<i>Caica melanocephala.</i>	— <i>notabilis.</i>
<i>Calopsitta novæ-hollandiæ.</i>	<i>Palæornis alexandri.</i>
<i>Calyptorhynchus banksii.</i>	— <i>erythrognys.</i>
<i>Chrysotis agilis.</i>	— <i>longicaudus.</i>
— <i>collaria.</i>	— <i>torquata.</i>
— <i>festiva.</i>	<i>Pionus menstruus.</i>
— <i>levaillantii.</i>	— <i>sordidus.</i>
— <i>ochrocephala.</i>	<i>Platycercus eximius.</i>
<i>Conurus æruginosus.</i>	— <i>pallidiceps.</i>
— <i>aureus.</i>	— <i>zonarius.</i>
— <i>aztec.</i>	<i>Pæocephalus fuscicapillus.</i>
— <i>hæmatorrhous.</i>	— <i>senegalensis.</i>
— <i>holochlorus.</i>	<i>Prioniturus, sp.</i>
— <i>jendaya.</i>	<i>Psephotus hæmatogaster.</i>
— <i>monachus.</i>	— <i>pulcherrimus.</i>
— <i>nanday.</i>	<i>Psittacus erithacus.</i>
— <i>pavua.</i>	<i>Psittacula passerina.</i>
— <i>petzii.</i>	<i>Psittinus malaccensis.</i>
— <i>xantholæmus.</i>	<i>Pyrrhulopsis splendens.</i>
<i>Coracopsis barklyii.</i>	<i>Pyrrhura leucotis.</i>
<i>Cyanorhamphus auriceps.</i>	— <i>vittata.</i>
— <i>novæ-zealandiæ.</i>	<i>Stringops habroptilus.</i>
<i>Eclectus polychlorus.</i>	<i>Tanygnathus muelleri.</i>
<i>Eolophus roseicapillus.</i>	<i>Trichoglossus concinnus.</i>
<i>Eos indica.</i>	— <i>novæ-hollandiæ.</i>

The points to which my attention has been directed, on account of the variations observed, are :—

1. The arrangement of the carotid arteries ;
2. The presence or absence of the ambiens muscle ;
3. The presence or absence of the furcula ;
4. The presence or absence of the oil-gland ;

and others of minor importance, such as the complete encirclement of the orbit by bone, and the peculiarities of the atlas vertebra. These will be considered separately.

I. *The arrangement of the carotid arteries among the Parrots.*

In my paper on the carotid arteries of birds, the peculiarities of these vessels in the Parrots are described, it being shown that three different arrangements of these vessels obtain, and perhaps a fourth. Either the two carotids may run normally, independent, and side by side up the front of the neck, in the hypapophysial canal ; or the right, as usual, traverses that canal, whilst the left runs superficially along the side of the neck in company with the left pneumogastric nerve and the jugular vein ; or the left carotid may alone be developed, as in the Passeres and many other birds. It has been stated that Meckel found a fourth arrangement in *Cacatua sulphurea* ; but in a specimen of that species recently dissected by me, the left only was present, as in *C. cristata*, *C. leadbeateri*, and *C. galerita*.

To make this paper complete in itself, and to incorporate those dissections performed since the other was published, a list of all the Parrots which I have examined, together with the condition observed in them is given.

1. The two carotids are present, running normally, side by side, in

<i>Agapornis,</i>	<i>Loriculus,</i>
<i>Aprosmictus,</i>	<i>Lorius,</i>
<i>Calopsitta,</i>	<i>Melopsittacus,</i>
<i>Calyptorhynchus,</i>	<i>Palæornis,</i>
<i>Eclectus,</i>	<i>Prioniturus,</i>
<i>Eolophus,</i>	<i>Psittinus,</i>
<i>Eos.</i>	<i>Stringops,</i>
<i>Euphema,</i>	<i>Tanygnathus,</i>
<i>Geopsittacus,</i>	<i>Trichoglossus.</i>
<i>Licmetis,</i>	

2. The left carotid only is present in
Cacatua.

3. The two carotids are present, the right having its normal course, the left running superficially along with the left pneumogastric nerve in

<i>Ara,</i>	<i>Chrysotis,</i>
<i>Bolborhynchus,</i>	<i>Conurus,</i>
<i>Brotogeris,</i>	<i>Coracopsis,</i>
<i>Caica,</i>	<i>Cyanorhamphus,</i>

Lathamus,
Nestor,
Pionus,
Platycercus,
Pæocephalus,

Psephotus,
Psittacus,
Psittacula,
Pyrrhulopsis,
Pyrrhura.

It may be observed that the only other well-defined groups of birds in which the carotids vary are the Cypselidæ, Gallinæ, Struthionæ, and Otididæ.

II. *The presence or absence of the ambiens muscle.*

The ambiens muscle, the tendon of which crosses the front of the knee-capsule obliquely from above downwards and outwards, and ultimately forms part of the flexor perforans digitorum, is present in the following genera—

Ara,
Bolborhynchus,
Caica,
Conurus,

Nestor,
Pæocephalus,
Psittacus,
Stringops.

It is absent in

Agapornis,
Aprosmictus,
Brotogerys,
Cacatua,
Calopsitta,
Calyptorhynchus,
Chrysotis,
Coracopsis,
Cyanorhamphus,
Eclectus,
Eolophus,
Eos,
Euphema,
Geopsittacus,
Lathamus,

Licmetis,
Loriculus,
Lorius,
Melopsittacus,
Palæornis,
Pionus,
Platycercus,
Prioniturus,
Psephotus,
Psittacula,
Psittinus,
Pyrrhulopsis,
Pyrrhura,
Tanygnathus,
Trichoglossus.

The only other well-defined groups of birds in which the ambiens muscle is known to vary are the Columbæ and the Struthionæ.

III. *The presence or absence of the furcula.*

By this expression is meant the presence or absence of the furcula as a complete bone; for in those Parrots in which it is said to be absent, the scapular ends of the two parts of which it is composed are frequently to be found, being of considerable length in *Stringops* and some of its allies.

The furcula is complete in

Aprosmictus,
Ara,
Bolborhynchus,

Brotogerys,
Cacatua,
Caica,

<i>Calopsitta,</i>	<i>Nestor,</i>
<i>Calyptorhynchus,</i>	<i>Palaeornis,</i>
<i>Chrysotis,</i>	<i>Pionus,</i>
<i>Conurus,</i>	<i>Pæocephalus,</i>
<i>Coracopsis,</i>	<i>Prioniturus,</i>
<i>Eclectus,</i>	<i>Psittacus,</i>
<i>Eolophus,</i>	<i>Psittinus,</i>
<i>Eos,</i>	<i>Pyrrhulopsis,</i>
<i>Lathamus,</i>	<i>Pyrrhura,</i>
<i>Licmetis,</i>	<i>Tanygnathus,</i>
<i>Loriculus,</i>	<i>Trichoglossus.</i>
<i>Lorius,</i>	

The furcula is but partially developed or absent in

<i>Agapornis,</i>	<i>Platycercus,</i>
<i>Cyanorhamphus,</i>	<i>Psephotus,</i>
<i>Euphema,</i>	<i>Psittacula,</i>
<i>Geopsittacus,</i>	<i>Stringops.</i>
<i>Melopsittacus,</i>	

Dr. Finsch, in his monograph on the Parrots*, has given a list of those species in which the condition of the furcula has been recorded, which is very complete, embracing most of the above genera.

IV. *The presence or absence of the oil-gland.*

When present the oil-gland is always tufted in the Parrots. Nitzsch, in his work on pterylosis†, has recorded its absence in some of the genera.

It is present in the following genera:—

<i>Agapornis,</i>	<i>Loriculus,</i>
<i>Aprosmictus,</i>	<i>Lorius,</i>
<i>Ara,</i>	<i>Melopsittacus,</i>
<i>Bolborhynchus,</i>	<i>Nestor,</i>
<i>Caiica,</i>	<i>Palaeornis,</i>
<i>Calopsitta,</i>	<i>Platycercus,</i>
<i>Calyptorhynchus,</i>	<i>Pæocephalus,</i>
<i>Conurus,</i>	<i>Prioniturus,</i>
<i>Coracopsis,</i>	<i>Psephotus,</i>
<i>Cyanorhamphus,</i>	<i>Psittacula,</i>
<i>Eclectus,</i>	<i>Psittacus,</i>
<i>Eolophus,</i>	<i>Psittinus,</i>
<i>Eos,</i>	<i>Pyrrhulopsis,</i>
<i>Euphema,</i>	<i>Pyrrhura,</i>
<i>Geopsittacus,</i>	<i>Stringops,</i>
<i>Lathamus,</i>	<i>Tanygnathus,</i>
<i>Licmetis,</i>	<i>Trichoglossus.</i>

It is absent in

<i>Brotogeris,</i>	<i>Chrysotis,</i>	<i>Pionus.</i>
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* Die Papageien, Bd. i. p. 197.

† Pterylography, English edition, p. 98 *et seq.*

In *Cacatua galerita* and *C. leadbeateri* it is present; but it is generally wanting in *C. cristata*, and has not been found in *C. sulphurea*.

The above facts may be tabulated in a form which makes their significance more readily apparent, by placing those together in which a similar arrangement is observable. Thus there are:—

1. Parrots in which there are two normally situated carotids, no ambiens muscle, a furcula, and an oil-gland—namely

<i>Aprosmictus,</i>	<i>Loriculus,</i>
<i>Calopsitta,</i>	<i>Lorius,</i>
<i>Calyptorhynchus,</i>	<i>Palæornis,</i>
<i>Eclectus,</i>	<i>Prioniturus,</i>
<i>Eolophus,</i>	<i>Psittinus,</i>
<i>Eos,</i>	<i>Tanygnathus,</i>
<i>Licmetis,</i>	<i>Trichoglossus.</i>

2. Parrots in which there are two normally situated carotids, no ambiens muscle, no furcula, and an oil-gland—namely

<i>Agapornis,</i>	<i>Geopsittacus,</i>
<i>Euphema,</i>	<i>Melopsittacus.</i>

3. Parrots with a left carotid only, no ambiens muscle, a furcula, and generally an oil-gland—namely

Cacatua.

4. Parrots with two carotids (the left being superficial), an ambiens muscle, a furcula, and an oil-gland—namely

<i>Ara,</i>	<i>Nestor,</i>
<i>Bolborhynchus,</i>	<i>Pæocephalus,</i>
<i>Caica,</i>	<i>Psittacus.</i>
<i>Conurus,</i>	

5. Parrots with two carotids (the left being superficial), no ambiens muscle, a furcula, and an oil-gland—namely

<i>Coracopsis,</i>	<i>Pyrrhulopsis,</i>
<i>Lathamus,</i>	<i>Pyrrhura.</i>

6. Parrots with two carotids (the left being superficial), no ambiens muscle, a furcula, and no oil-gland—namely

<i>Brotogerys,</i>	<i>Pionus.</i>
<i>Chrysotis,</i>	

7. Parrots with two carotids (the left being superficial), no ambiens muscle, no furcula, and an oil-gland—namely

<i>Cyanorhamphus,</i>	<i>Psephotus,</i>
<i>Platycercus,</i>	<i>Psittacula.</i>

The true significance of these facts next requires attention; and the principle upon which all attempts at the formation of a satisfactory genealogy or classification of the suborder can be arrived at must

be borne in mind throughout. It is the following:—An anatomical character is so much the more or less certain to have been an element of the original type or ancestor whence sprang the class, order, family, or genus under consideration as it is more or less frequently found in the less intimately related minor divisions of the groups under observation. An example will make this more clear:—Two large arteries (the carotids), one on each side, run up to supply the head in most Pulmonate Vertebrata, as far as I know. In all Mammalia such is certainly the case. In many Birds there are, similarly, two carotids, though some have only one. It is therefore more than probable that the ancestral bird had two carotids, those in which one is absent having lost it subsequently. Many Parrots have two carotids; the genus *Cacatua* is characterized by the left only being present: it, therefore, has in this respect departed most from the ancestral type. Again, other Vertebrata and other Birds with both carotid arteries present have them symmetrically placed; many Parrots have symmetrical carotids; but in some the left (and the left only) is abnormal in being superficial: therefore, from the same considerations, these last have differentiated off from the parent stem, and, what is more, this peculiarity can hardly have occurred on more than one occasion, as it is otherwise unique and therefore peculiar and exceptional in origin.

There is another principle to be remembered, which is that there is no such thing as reversion to lost ancestral anatomical characters. The genus *Cacatua* has lost its right carotid, as have the whole family of the Passeres and many others. There is not a tittle of evidence in favour of the assumption that they or their descendants could ever regain that vessel. Its arrested development is a positive act, the result of extra forces coming into play in early embryonic life, to remove which would require the introduction of a certain definite series of counterbalancing forces superadded to those already in action; whilst, in the ancestral bird, the persistence of the two arteries resulted from the absence of any impediment to their development. The probability that the ancestral form should be reverted to cannot be greater than that an entirely new arrangement should be effected. That some domestic eccentric varieties should tend in some cases to revert to the wild type can have no more bearing on the general subject than the similar tendency to exaggeration which is not apparent in the feral forms.

Upon these principles many deductions can be made as to the mutual relations of the several genera of the Psittacine suborder. For instance, it must be inferred that the ancestral Parrot possessed two carotids, running symmetrically in front of the neck, and that the ambiens muscle was present, as was the furcula and the tufted oil-gland. The intestinal cæca and gall-bladder must have been absent or lost very early, as must the postacetabular portion of the tensor fasciæ muscle*; for they are none of them to be found in any existing species; whilst the beak, tongue, crop, and rectrices must have possessed the characteristic features, which are not found to vary to any important extent. The pterylosis of the suborder forms a consider-

* *Vide* P. Z. S. 1873, p. 628.

able but much involved field for work, which has only been entered upon by the illustrious Nitzsch.

Referring back to the characterizing features of the existing species whose internal structure has been noted, it will be seen that none has as yet been found with a conformation exactly similar to that of the above-described ancestral bird; in other words, no existing Parrot has been seen with two normal carotids, an ambiens muscle, a furcula, and an oil-gland. By more than a single way, however, this condition, with only one exceptional character, is found to exist. For instance, the fourth combination above given, in which the ambiens, furcula, and oil-gland are present at the same time that the carotids are abnormal (the left being superficial), agrees with the type except in one point—the disposition of the carotid arteries. Again, in the first of the combinations the only deviation from the type consists in the absence of the ambiens muscle.

These two different directions of variation must therefore have formed the secondary stems from which the more specialized genera subsequently sprang. In other words, the main stem must have given rise to two, in one of which the carotids remained normal, whilst in the other the left became superficial. The following are the genera as they will thus appear:—

Genera in which the left carotid
has remained normal.

(PALÆORNITHIDÆ.)

Agapornis.
Aprosmictus.
Cacatua.
Calopsitta.
Calyptorhynchus.
Eclectus.
Eolophus.
Eos.
Euphema.
Geopsittacus.
Loriculus.
Lorius.
Melopsittacus.
Palæornis.
Prioniturus.
Psittinus.
Stringops.
Tanygnathus.
Trichoglossus.

Genera in which the left carotid
has become superficial.

(PSITTACIDÆ.)

Ara.
Bolborhynchus.
Brotogerys.
Caica.
Chrysotis.
Conurus.
Coracopsis.
Cyanorhamphus.
Lathamus.
Nestor.
Pionus.
Platycercus.
Pæocephalus.
Psephotus.
Psittacus.
Psittacula.
Pyrrhulopsis.
Pyrrhura.

Each of these secondary types must have then become a centre for variation in itself. From the 4th combination, in which only the carotids are peculiar, sprang the 5th, 6th, and 7th, with the ambiens deficient, just in the same way that the 1st, 2nd, and 3rd combinations originated from the ancestral form by the same process of reduction. The loss of the furcula and of the oil-gland (though

never, as it happens, both together) have further aided in the formation of tertiary and further subdivisions, which, upon the dissections above given, would lead to the arrangement of the family which is depicted in Plate LXX.

This may be represented in the tabular form as follows:—

Suborder (or Cohort) PSITTACI.

Family I. PALÆORNITHIDÆ. (Left carotid normal.)

The ambiens muscle absent. Carotids two, except in the genus *Cacatua*.

Subfamily (1) PALÆORNITHINÆ. No further deviation.

Palæornis.
Eclectus.
Aprosmictus.
Tanygnathus.
Prioniturus.
Psittinus.
Loriculus.
Trichoglossus.
Lorius.
Eos.

Subfamily (2) CACATUINÆ. Orbital ring completely ossified, and characteristic in that it develops a process bridging the temporal fossa (*vide* Plate LXXI.).

Calopsitta.
Calyptorhynchus.
 { *Licmetis.*
 Eolophus.
 { *Cacatua.*

Subfamily (3) STRINGOPINÆ. The furcula lost*.

Stringops.
 { *Euphema.*
 Geopsittacus.
 { *Melopsittacus.*
 Agapornis.

Family II. PSITTACIDÆ. (Left carotid superficial.)

Division 1. The ambiens muscle present.

Subfamily (4) ARINÆ. No further deviation.

{ *Ara.*
 Conurus.
 { *Bolborhynchus.*
 Caïca.
 Psittacus.
 Pæocephalus.
 Nestor.

* See the special remarks on this group in the postscript to this paper.